

AMENDMENT UNDER 37 C.F.R. §1.111
U.S. Appln. No. 10/024,187

REMARKS

Review and reconsideration on the merits are requested.

Applicants appreciate the Examiner examining claim 7 on the merits.

The prior art: U.S. 2002/0110739 McEwen et al (McEwen); U.S. 6,190,805 Takeuchi et al (Takeuchi); U.S. 4,643,958 Thrash et al (Thrash).

Applicants appreciate the Examiner indicating that claim 7 is merely objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form, including all of the limitations of the base claim and any intervening claims.

Applicants rewrite claim 7 which depended directly from claim 1 in independent form, including the subject matter of claim 1.

The rejections: claims 1-6 were rejected under 35 U.S.C. § 102(e) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over McEwen.

Claims 1-6 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Takeuchi in view of Thrash.

The above rejections are respectfully traversed.

The Examiner's position on the prior art is set forth in detail in the Action and will not be repeated here except as necessary to an understanding of Applicants' traversal which is now presented.

Since Applicants believe that the features of the present invention which distinguish the prior art are recited in claim 1 as now amended, they discuss only claim 1 as currently amended (claim 1).

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In claim 1, one major distinguishing feature of the invention is found in that the polymer prepared by a Michel-type addition reaction between an electrophile having at least two polarized unsaturated bonds and a nucleophile having a plurality of nucleophilic groups in the presence of a basic metal salt is a cross-linked polymer having a cross-linked structure including at least one hetero-atom, that is, it is a cross-linked polymer cross-linked by an atomic group having a substructure of a -C-C-hetero atom- at two or more positions adjacent to an electron-withdrawing group, where the hetero atom is at least one atom selected from the group consisting of S, N, and O (see page 14, lines 7-10; page 21, line 4 to -page 22, line 1 of the specification).

The electrolyte composition of the present invention which comprises the above cross-linked polymer is easily prepared by reaction between an electrophile having at least two polarized unsaturated bonds and a nucleophile having a plurality of nucleophilic groups, e.g., -NH₂, -SH, -S⁻, -SO₂H and -SO₂⁻, -OH, -COOH, etc., in a molten salt represented by any one of the general formulae (1), (2) and (3) set forth in claim 1. The reaction will provide an electrolyte composition which can be used in a non-aqueous electrolyte secondary cell and provides excellent cell characteristics (underscoring has been added; see the specification at page 2, lines 11-16, page 4, lines 26-29 and page 9, lines 8-11).

In contrast to the present invention, the Gel Polymer Electrolytes (GPE)/polymer matrixes of McEwen are produced using a radically polymerizable monomers, such as acrylate monomers, in the presence of a small amount of a radical forming compound such as ABIN or BBO using ultraviolet light. See McEwen at paragraphs [0067] to [0072].

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The specification of the present application teaches not only that cell characteristics such as relative capacitance and cycle capacitance of the present invention are superior but also teaches that leakage of the materials of Examples 1 to 11 using electrolyte composition films F1 to F11 of the present invention (prepared by the method in claim 7 herein), are superior to those of Comparative Examples 1-6 presented in Tables 2 and 3 which use electrolyte composition film F16 as shown in Table 1. Electrolyte composition film F16 is prepared by radical-polymerizing radically polymerizable monomers, hydroxyethylmethacrylate (HEMA) and ethyleneglycol dimethacrylate (EGDMA) in an inorganic salt with a free-radical initiator in almost the same manner as disclosed in paragraph [0070] of McEwen.

Specifically, the specification of the present application thus teaches superior cell characteristics such as relative capacitance, cycle capacitance and leakage (Examples 1 to 11 using electrolyte composition films F1 to F11) are superior to those obtained using the materials of Comparative Examples 1-6 using electrolyte composition film F16 prepared by radical polymerization of radically polymerizable monomers, hydroxyethylmethacrylate (HEMA) and ethyleneglycol dimethacrylate (EGDMA) in an inorganic salt with a free-radical initiator in almost the same manner as disclosed in paragraph [0070] of McEwen.

Applicants thus respectfully submit that the claims herein are not anticipated by McEwen nor rendered obvious by McEwen which does not teach or suggest any electrolyte composition comprising a cross-linked polymer crosslinked by an atomic group having a substructure of -C-C-hetero atoms (such as at least one of S, N and O) at two or more positions adjacent an electron withdrawing group prepared by conducting reaction between an electrophile having at least two

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unsaturated bonds polarized by an electron-withdrawing group and a nucleophile having a plurality of nucleophilic groups in a molten salt where a radically polymerizable monomer is not used.

Withdrawal is requested.

Since claims 2-6 depend from claim 1, Applicants submit their patentability is clear over the above discussion regarding claim 1.

Applicants now address the rejection of claims 1-6 under 35 U.S.C. § 103(a) over Takeuchi further in view of Thrash.

As earlier explained per the present invention, the electrolyte composition comprising a cross-linked polymer cross-linked by an atomic group having a substructure -C-C-hetero atom, where the heteroatom is, for example, at least one of S, N and O, at two or more positions adjacent to an electron-withdrawing group is prepared by conducting a reaction between the specified electrophile and the specified nucleophile, reaction being in a molten salt. See claim 1, page 14, lines 4-10 and page 19, lines 8-13 of the specification.

In contrast to the invention of claim 1, Takeuchi discloses a highly ion conductive solid polymer electrolyte comprising a polymer having a cross-linked and/or side chain group mainly comprising a poly-or oligo-carbonate group and an electrolyte salt. (underscoring has been added; see Takeuchi at col. 5, lines 39-42).

The structure of the polymer in Takeuchi in the highly ion conductive solid polymer electrolyte of Takeuchi has no hetero-atom N, S and O bonded to a C atom of a C= C group. This is completely different from that of the electrolyte composition of the present invention

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which comprises a cross-linked polymer cross-linked by an atomic group having a substructure -C-C-hetero atom, such as at least one of S, N and O, at two or more positions adjacent to an electron withdrawing group. See also col. 18, line 66 to col. 19, line 9 of Takeuchi.

Since Takeuchi is silent regarding an electrolyte composition comprising a cross-linked polymer cross-linked by an atomic group having a substructure -C-C-hetero atom (such as at least one of S, N and O)- prepared by a Michael-type addition reaction between an electrophile and a nucleophile (as claimed) in a molten salt, one of ordinary skill in the art would not be motivated to reach the invention of claim 1. Accordingly, claim 1 is not obvious over Takeuchi.

However, the rejection is over Takeuchi in view of Thrash, and Applicants now address the teaching of Thrash.

Thrash discloses electrochemical cells based on lithium-sulfur dioxide which use a minor amount of a quinone imine as an electrolyte additive. The quinone imine improves the characteristics of the Thrash cells (see Col. 2, lines 55-66 and col. 3, lines 60-66) in which various combinations of electrolyte salts comprising at least one material selected the group consisting of salts containing metal cation complexes, quaternary ammonium salts, phosphonium salts, pyridinium salts, and arsonium salts, with one or more lithium salts being preferably used, and also teaches a liquid sulfur dioxide solution in $\text{Mn}(2,2'\text{-dipyridyl})_3(\text{ClO}_4)_2$ saturated in lithium perchlorate (LiClO_4) as an electrolyte (see col. 6, lines 47-57 and col. 8, col. 46-49, Example 1).

Thrash thus teaches improving the characteristics of the Thrash cells by adding various combinations of electrolyte salts as above discussed. However, Thrash is completely silent

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regarding the preparation of any cross-linked polymers cross-linked by an atomic group having a substructure -C-C-hetero atom (such as at least one of S, N and O) at two or more positions adjacent to an electron-withdrawing group prepared by adding an electrophile and a nucleophile to the molten salt of Thrash to effect a Michel-type addition reaction between the electrophile and the nucleophile.

Accordingly, even if one of ordinary skill in the art were to modify Takeuchi in view of Thrash, one would not reach claim 1 of the present invention.

Applicants further submit that there is no reason or motivation that one of ordinary skill in the art would be motivated to combine or modify Takeuchi in view of Thrash.

In summary, neither Takeuchi nor Thrash teach or suggest, alone or in combination, an electrolyte composition comprising a cross-linked polymer cross-linked by an atomic group having a substructure -C-C-hetero atom (such as at least one of S, N and O)- prepared by a Michel-type addition reaction between an electrophile and a nucleophile as claimed in a molten salt, important features of the present invention as recited in claim 1.

Accordingly, claim 1 is not rendered obvious by the combination of Takeuchi and Thrash.

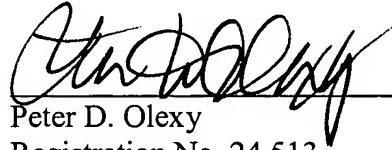
Applicants respectfully submit that claims 2-6, depending from claim 1, are patentable for the above reasons advanced with respect to claim 1.

The amendment to claim 1 is a narrowing amendment which limits claim 1 to the recited features and equivalents thereof.

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